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ABSTRACT

The purpose of this article is to set forth a conceptual framework to help educational administrators understand the applications and potential of data processing activities in their institutions. It is expected that such a framework will provide a basis for data processing decisions and direction for future data processing activities. The model presented cross classifies the means of data processing--manual, mechanical, electro-mechanical, and electronic--with three levels of data processing--clerical, control, and analysis. The authors then relate this framework to school systems and other educational systems and discuss some of the implications inherent in each level of data processing. An 18-item bibliography is included. (Author/DN)

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ACCOUNTABILITY AND DATA PROCESSING IN PUBLIC SCHOOLS

by

Guy D. Cutting and Stewart D. North

The purpose of this article is to set forth a conceptual framework to help educational administrators understand the applications and potential of data processing activities in their institutions. Presently administrators are involved in important decisions related to the installation of information systems and the utilization of modern data processing techniques. They are often forced to make pragmatic decisions, sometimes costly to the public, on bits of information gleaned from many sources without fully understanding the alternatives available.

According to the American Association of School Administrators,[7] less than five percent of American public school systems were using electronic data processing in any form in 1961. Today, a little more than a decade later, what was formerly the exception has become the rule. A rapid thrust of electronic data processing in education has occurred and during it administrators have gained familiarity with many aspects of data processing.

Presently there is a need for a framework which describes and gives order to educational data processing phenomena of the past and the

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present. Thus a basis for data processing decisions will be provided and direction for future data processing activities can be contemplated in an orderly fashion. An administrator may find the framework useful in gaining insight into the nature of his own school system's data processing activities, understanding data processing systems past and present, and considering directions appropriate for the future.

The Framework

Viewing data processing as a concept which represents a system of procedures directed toward the accomplishment of goals and which can be described in an hierarchy of levels is useful as data processing procedures are related to three general levels of sophistication: clerical, control, and analysis.[11] The least sophisticated of the three is the clerical level of data processing. The control level is second, and the third and highest level of sophistication is the analysis level.

It also becomes meaningful to differentiate between the several means which are available to process data: manual, mechanical (adding machine, abacus, slide rule), electro-mechanical (electric adding machine, electric calculator), and electronic (computers).[8]

The conceptual framework important to the modern administrator involves both the means and levels of data processing. A model and explanation is set forth below.

Means of Data Processing

Levels of Data Processing	Manual	Mechanical	Electro-Mechanical	Electronic
Analysis				
Control				
Clerical				

1. Clerical level; routine functions normally deemed appropriate for a clerk to perform. Very simply, data is "read" and "printed." Payroll procedures and class rosters are examples. In each instance data is "read" and "printed" in a predetermined format. These kinds of activities can be accomplished manually, mechanically, electro-mechanically, or electronically.

When computers are used, input devices ("read") and output devices ("print") are important to this level of processing. The central processing capabilities of the computer such as mathematical manipulations, logical comparisons, sorting and classifying, are not important.

USED	USED	USED
YES	NO	YES
Data Input Devices	Central Processing Capabilities	Data Output Devices

Further examples of clerical level applications which provide administrative services are: generation of reports, required documentation or certification and accreditation, grade and attendance reporting, [4, 12, 18] class lists, honor roll and academic difficulty reports, [12] and lists of equipment, supplies, and library holdings.

2. Control level; data processing activities at this level include the clerical procedures of "reading" and "printing" and also a certain amount of decision making (control).

Student scheduling is an example. When a student requests a course, a determination is made based upon space availability. If there is available space, the student will be assigned to the course. Or, if one section of the course is filled, the remaining sections will be checked for space availability. If there is no space available, the student will not be assigned.

Some budgeting procedures also reflect control level activities. A component, subsystem, or individual may request an expenditure of "X" amount of funds for item "Y". Before the expenditure is approved the account will be checked to see if sufficient funds are available. If they are, "Y" will be purchased. If not, the request will not be approved.

Like clerical level processes, control level data processing activities may be accomplished by manual, mechanical, electro-mechanical, or electronic means. When computers are used, their central processing capabilities are used to some extent. Comparisons, through the use of "IF STATEMENTS" are made within the central

processing unit of the computer. In the example given above, the "X" amount of money requested would be compared to the money remaining in the account. "IF" "X" amount was larger than the amount of money in the account, the request would not be approved.

USED	USED	USED
YES	PARTIALLY	YES
Data Input Devices	Central Processing Capabilities	Data Output Devices

Examples of other areas and activities where control level data processing applications are being made are: nursing and medical services, social work, guidance and career exploration.[3] The planning of menus based on nutrition, palatability and the cost of food complete with recipes generated for a specific number of students.[4] Transportation, routing, and scheduling,[4] student scheduling,[4, 12, 18] textbook control to ensure the right student has the right book at the right time,[5] registration,[12, 18] teacher assignments, state reports, etc.[12]

3. Analysis level; represented by systems which exercise forms of control and/or perform analyses such as statistical analyses. Similar to the other levels of data processing this level may also be accomplished by manual, mechanical, electro-mechanical, or electronic means. Continuing the previous budget example to include analyses of financial activities such as PPBS or EMRS or projections of financial needs would raise the control activity to the analysis level.

USED	USED	USED
YES	EXTENSIVELY	YES
Data Input Devices	Central Processing Capabilities	Data Output Devices

Use of electronic means for analysis purposes is one form of response to the increased complexity in required operations as man's activities have grown in scale and inter-relatedness. The rapid expansion of information and mutual dependencies of information have imposed problems to which electronic data processing provides a solution: it is a technical means by which man can handle extensive amounts of information and intricacies otherwise impractical or beyond him.[13]

The University of Southern California is using computer simulation to analyze world-wide political behavior between any of 169 nations.[5] Bucknell University has one third of their physics experiments run by computer simulation. Data for statistical analysis may be extracted from census records and student master records stored in computer systems. The computer may be used for program evaluation.[18] Analysis data may also be provided via the computer concerning curriculum, space availability and assignments, resources, sequencing procedures, counseling, admission and termination procedures, external agency procedures, information processing procedures, student background, decision-making procedures and research.[2] The

computer may also aid the administrator in population and personnel need predictions and building planning at this level of data processing activities.[12]

When compared to the clerical and control levels of data processing, it is the analysis level of activities which use the potential of electronic equipment. Extensive amounts of information, intricacies and interdependencies may be scanned, compared, reordered and mathematically and otherwise manipulated in seconds to: 1) aid in resolving material on abstract entities into their constituent elements; 2) provide decision makers with facts, knowledge, or information which they did not have before, and which is necessary to the successful operation of the organization.

The Application of the Framework

The purpose of this section is to relate the framework to school systems and/or other educational systems which are utilizing different levels of the levels of data processing discussed above and some implications which are, from the writer's view, inherent in each level.

1. Control Level Profile

Levels of Data Processing	Means of Data Processing: Manual	Mechanical	Electro-Mechanical	Electronic
Analysis				
Control	X	X	X	X
Clerical	X	X	X	X

This educational system is employing all four means of data processing; manual, mechanical, electro-mechanical, and electronic, which is typical and more often than not, efficacious. What is apparent is the lack of analysis level activities being conducted in the system. Its activities do not go beyond the clerical and control levels. Objectives may include student scheduling, transportation routing, textbook control, menu planning, keeping records of attendance to extra-curricula activities, etc.

The profile reflects activities which are "maintaining the status quo" in nature. There is not the analysis level of activities which retrieve, relate, correlate, etc., to bring new facts and knowledge to the decision maker to facilitate operational decision-making, continuous evaluation and modification, and other processes or objectives cited below in the analysis level profile. Procedures are planned, implemented,

and maintained to ensure the organization's efficient accomplishment of the daily routine.

The system may be maintaining the status quite harmoniously as well. Functioning very smoothly, to many observers it will appear to be a "well run" system with a good record of production. Those role incumbents satisfied with maintaining the status quo are fortunate to be in a situation which represents nomothetic-idiographic fusion. The objectives of the organization and the need dispositions of the indiviudals within the organization are indeed mutual--maintaining the status quo.

Those incumbents who do attempt to reach past the objectives of the system however, are apt to feel subjated and find it difficult to be aware of the whole of the system as opposed to the parts. They may be the role incumbents who are ambivalent, aggressive, or disinterested in the organization. Informal groups will be present to sanction such reactions. The individual and cumulative impact of such reactions and related defense mechanisms is to influence the input-output ratio of the system in such a way that a greater input (energy, money, machines) will be required to maintain a constant output. [1]

2. Clerical Level Profile

Levels of Data Processing	Means of Data Processing: Manual	Mechanical	Electro-Mechanical	Electronic
Analysis				
Control				
Clerical	X	X	X	X

Similar to the control profile, this educational system is also employing all four means of data processing. Also similar to the control level profile, planning and allocating and organizing have occurred and the objectives planned may well be the objectives being met. If so, they reflect clerical level data processing activities such as class rosters, payroll procedures, generation of reports, grade and attendance reporting, and lists of library holdings.

This educational system is one which has not systematized procedures to efficiently maintain the daily operation. Nor is maintaining the status quo done as efficiently or as harmoniously as in the control profile system. And because of the lack of systematized procedures to efficiently maintain the daily operation, this system expends more energy, requires more physical effort and mental effort to accomplish the daily routine, which it must do if it is to continue operating, than the control level system. Many administrators simply do not realize that the

information on which they are basing their most routine decisions may be dangerously inadequate or misleading, and that their data processing activities are not geared to meet the current needs of the organization.[13] Activities which are inadequate or misleading block the development of adequate information systems. Major indications and symptoms of inadequate data processing and information systems, often present in the clerical level system, are:

A. Operational indications
   1. Large physical inventory adjustments
   2. Capital expenditure overruns
   3. Inability of administrators to explain changes from year to year in operating results
   4. Unexplainable cost variances or inadequate cost information
   5. Lack of communications among personnel
   6. Insufficient knowledge about relevant practices in other educational systems

B. Psychological symptoms
   1. Surprise at financial results
   2. Poor attitude of personnel about usefulness of information
   3. Lack of understanding of financial information by administrators and other personnel
   4. Lack of concern for environmental changes

C. Report content signs

1. Excessive use of tabulations of figures or details
2. Multiple preparation and distribution of identical data
3. Conflicting information generated from different sources
4. Lack of periodic comparative information and trends or standards for comparison
5. Lateness of information
6. Inaccurate information
7. Inadequate externally generated information

3. Analysis Level Profile

Levels of Data Processing	Means of Data Processing: Manual	Mechanical	Electro-Mechanical	Electronic
Analysis	X	X	X	X
Control	X	X	X	X
Clerical	X	X	X	X

This profile represents an educational system using all means of data processing and all levels of data processing, from the "read" and "write" activities of the clerical level to the sophisticated activities of the analysis level to facilitate the system accomplishing its goals and objectives.

The uses of educational data processing are limited only by the imagination of the users in this system. Nowhere in those systems represented by clerical and control level profiles is there the opportunity to involve all the people within the system, as there is in this one. Creativeness and commitment on the part of the professional personnel in the organization make such a profile possible and also make possible the maintenance of such a profile.

It is this kind of system which is most able to:[10]

1. Accommodate itself to new and different population patterns.

2. Be capable of utilizing new technological developments for educational purposes.

3. Capitalize on the many other educational forces which exist in society.

4. Be able to bring learners in contact with a wide variety of realistic learning experiences.

5. Accommodate itself to changes in the natural resources available to man.

6. Be capable of coping with increased amounts of information.

7. Be concerned with the economy of learning.

8. Emphasize the development of learning skills.

9. Progressively involve the learner in making decisions about his educational program.

10. Develop broadly educated specialists.

11. Emphasize human relations

12. Provide the means by which individuals can determine overriding purposes in their lives.

13. Help individuals break down the dichotomy between work and play.

14. Help each individual, regardless of characteristics and previous condition, to release the potential he possesses.

15. Shape the educational system of the future in purposive fashion, not by default, accident, or senseless forces.

4. Diminishing Return Profile

Levels of Data Processing	Means of Data Processing: Manual	Mechanical	Electro-Mechanical	Electronic
Analysis	X			
Control	X	X	X	
Clerical	X	X	X	X

This profile was especially common when electronic means of data processing first appeared in educational settings. Early efforts, and many later efforts have confined the use of computers to clerical level processes. As systems represented by the above profile move more toward the analysis level profile in the area of electronic means,

"inversion" will take place and the professional personnel within the systems will be freed to administer rather than bound to completing data processing tasks which could be completed more efficiently be electronic means.

As complex and interrelated and sophisticated as modern educational organizations are, man's productivity decreases when he is burdened with completing analysis level tasks which can better be completed by hardware.[8] This phenomenon of decreasing productivity will be compounded as organizations grow in size and complexity in the future. The only answer, however, is not just computers--as far as the kind of equipment which is costly and man, school systems cannot afford--but computer centers, if you will. Electro-mechanical equipment can greatly facilitate professional personnel and so can electronic equipment such as "suitcase" sized computers and teletypes with full E level Fortran IV capability (as well as a number of other computer languages) for a total purchase price of less than $6,500. Or desk size computers to which one can add memory units and other hardware and which are approximately $3,300. Also, time sharing and service linkages with institutions of higher education and education service centers may be functional relationships for those systems not able to, or not desirous of, maintaining their own computer centers.

Assumptions Related to the Framework

Knowledge of modern data processing methods is central to optimizing an educational system's ability to obtain its goals and objectives as the success of any system is dependent upon sufficient data.[9] An inadequate supply of data is likely to lead to the failure or partial failure of the system.

Data processing needs may vary from one system to another and the combinations of levels of data processing and means of data processing, the system's profile, may also vary to properly satisfy these needs. The development of procedures to meet the system's needs should be planned and continuously evaluated or the system is leaving to chance the kind and amount of data that it is operating upon.

Leaving data processing procedures to chance or partially to chance, is to leave the system's information system to chance. Many managements have experienced that the data processing and information systems must be integrated with the data processing system becoming a subsystem of the information system.[11] In this light, the nature of an information system is, or is in part, a function of the nature of the data processing system.

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